A MIOSPORE ASSEMBLAGE FROM THE PERMIAN OF IRAQ

by H. P. SINGH

ABSTRACT. A dispersed miospore assemblage comprising 32 genera and 49 species is described from a shale core sample. Two miospore genera, *Iraqispora* and *Mosulipollenites*, and 27 species are new. The material is from Atshan well in the Chia Zairi formation near Mosul in northern Iraq. The miospore flora described here is compared with comparable spore floras of Permian age. On the basis of this study, it is suggested that this spore composition corresponds to an Upper Permian age.

THE miospore flora described in this paper was obtained by macerating a shale core sample from the Chia Zairi formation (Permian) 801 feet below the top of the Atshan well which lies at a distance of about 12 miles west of Mosul in northern Iraq. The lithological sequence of this formation, as reported by Wetzel (1956), shows that the Chia Zairi formation overlies the Harur limestones (Lower Carboniferous) unconformably, but is in turn conformably overlain by the Mirga Mir formation which is of Lower Triassic age.

This miospore assemblage is referred to 32 genera and 49 species, of which 2 genera, *Iraqispora* and *Mosulipollenites*, and 27 species are new. Two miospore genera, *Vestigisporites* (Balme and Hennelly) Hart and *Fimbriaesporites* Leschik, are critically examined. The spore assemblage is described, illustrated and arranged according to the artificial system of classification proposed by Potonié and Kremp (1954) and subsequently modified by Potonié (1956, 1958, and 1960).

A comparison of the Iraqi miospore assemblage has been made with the miospore floras described by Jansonius (1962), Jizba (1962), Wilson (1962), Imgrund (1960), Høeg and Bose (1960), Hart (1960), Bharadwaj (1960), Piérart (1959), Leschik (1956 and 1959), Balme and Hennelly (1955 and 1956*a*, *b*), Potonié and Klaus (1954), and Samoilovich (1953). On this basis, it is contended that the Iraqi spore assemblage more closely resembles those assemblages from the northern hemisphere than those from the southern hemisphere. However, the Iraqi assemblage differs from both Northern and Southern Permian assemblages, by possessing such genera as *Iraqispora*, *Mosulipollenites*, *Schopfites*, and *Kraeuselisporites* which are not known from any other Permian strata as yet.

Method of spore preparation. The miospores were extracted by macerating the shale sample in cold commercial hydrofluoric acid for 24 hours. The residue was thoroughly washed with water, centrifuged and then warmed with 50 per cent. nitric acid for 5 minutes. After this, the acid was decanted off and the washed acid-free material was further digested with a dilute solution of ammonia. The macerate was thoroughly washed with acetone and centrifuged in a solution of bromoform, diluted with acetone (1/6 volume). The float was washed free of bromoform with acetone and stored in a vial containing glycerine jelly. For the analysis of miospores, single spore mount preparations as well as general slides were made in glycerine jelly medium. All the slides, numbering from V.44220–V.44276, have been deposited in the Palaeontology Department of the British Museum (Natural History).

[Palaeontology, Vol. 7, Part 2, 1964, pp. 240-65, pls. 44-46.]

Acknowledgements. I am deeply grateful to Dr. W. G. Chaloner for valuable suggestions and helpful advice. I am also grateful to the Iraq Petroleum Company for making available the sample which forms the subject of this paper and to Dr. J. M. Pallot who carried out the maceration. My thanks are due to the authorities of the Commonwealth Technical Co-operation scheme for awarding me the Colombo Plan Scholarship during the tenure of which this work was started in the Botany Department, University College London, and to the authorities of the Birbal Sahni Institute of Palaeobotany for the grant of study leave.

DESCRIPTION OF DISPERSED SPORES

Anteturma SPORITES H. Pot. 1893
Turma TRILETES (Reinsch) Pot. and Kr. 1954
Subturma AZONOTRILETES Luber 1935
Infraturma LAEVIGATI (B. and K.) R. Pot. 1956
Genus LEIOTRILETES (Naum.) Potonié and Kremp 1954

Leiotriletes atshanensis sp. nov.

Plate 44, figs. 1, 2

Holotype. Plate 44, fig. 1; slide V.44225.

Diagnosis. Size 35–45 μ (15 specimens), Y-rays two-thirds to three-quarters the radius, exine 1·5–2 μ thick, strongly intrapunctate.

Description. Holotype 42 μ, triangular with broad angles and straight to slightly concave sides. Trilete mark distinct, Y-rays simple, equal, usually three-quarters the radius, ray-ends occasionally bifurcating. Exine 1·5 μ thick, finely but densely intrapunctate. Margin of the spore smooth. Secondary folds rare.

Comparison. Leiotriletes gracilis Imgr. and *L. directus* Balme and Henn. differ in having elevated and sinuous Y-rays. Apparently, *L. sphaerotriangulus* (Loose) Pot. and Kr. is comparable with *L. atshanensis* but it differs by virtue of its thinner exine and longer Y-rays. Other species do not compare closely.

Leiotriletes magnificus sp. nov.

Plate 44, figs. 3, 4

Holotype. Plate 44, fig. 3; slide V.44220.

Diagnosis. Size 22–33 μ (15 specimens), triangular with straight-convex sides. Y-rays more than three-quarters of the radius, exine 0·5–1·0 μ thick, very finely intrapunctate.

Description. Holotype 30 μ, triangular with straight to convex sides and rounded corners. Trilete mark distinct, Y-rays long, simple, ray-ends hair thin. Exine about 1 μ thick, finely intrapunctate, rarely folded. Margin of the spore smooth.

Comparison. Leiotriletes atshanensis differs from this species by having a greater size and thicker exine. *L. sporadicus* (Imgr.) Pot. & Kr. has a laevigate exine, and longer Y-rays with apparently raised apex and smaller size (20–26 μ). *L. gracilis* Imgr. differs in possessing thicker exine and distinct labra. *L. subadnatoides* Bhard. has broader angles and thicker exine. *L. adnatus* (Kos.) Pot. & Kr. is different in being larger.

Leiotriletes cf. *gracilis* Imgrund 1960

Plate 44, fig. 5

Description. Miospore triangular with straight to slightly concave sides and round angles. Trilete mark distinct, Y-rays ending slightly before the equator. Exine $\pm 1\ \mu$ thick in optical section, intrapunctate, secondary folds apparent.

Comparison. In size, thickness of exine, and the length of Y-rays the specimen referred here as *L.* cf. *gracilis* compares well with the illustration of the holotype of *L. gracilis* Imgr., but it does not show distinctly the broad labra of the holotype.

Leiotriletes rarus sp. nov.

Plate 44, fig. 6

Holotype. Plate 44, fig. 6; slide V.44235.

Diagnosis. Size 25–35 μ (10 specimens), Y-rays three-quarters the radius, bounded by concave, darker, thicker, and about 3 μ broad, bands of interradial exine; exine approximately 1 μ thick, intrapunctate, sometimes folded.

Description. Holotype 30 μ, triangular with broadly rounded corners and straight to slightly convex sides. Trilete mark conspicuous, Y-rays extending up to three-quarters

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EXPLANATION OF PLATE 44

All figures are from unretouched negatives and unless otherwise stated are $\times 500$.

Figs. 1–6. *Leiotriletes spp.* 1–2, *L. atshanensis* sp. nov. 1, Proximal face; V.44225. 2, Proximal face; V.44223. 3–4. *L. magnificus* sp. nov. 3, Proximal face; V.44220. 4, Proximal face; V.44275. 5, *L.* cf. *gracilis* Imgr., proximal face; V.44220. 6, *L. rarus* sp. nov., proximal face; V.44235.

Figs. 7–8. *Iraqispora labrata* gen. et sp. nov. 7, Proximal face; V.44256. 8, Laterally compressed; V.44223.

Figs. 9–14. *Punctatisporites spp.* 9, *P. obliquus* Kos., laterally compressed; V.44249. 10, *P. pyramidicus* sp. nov., proximal face; V.44237. 11–12. *P. spathulatus* sp. nov. 11, Distal face; V.44223. 12, Proximal face; V.44224. 13–14. *P. sp.* 13, Proximal face; V.44220. 14, Proximal face; V.44226.

Fig. 15. *? Retusotriletes sp.*, proximal face; V.44236.

Fig. 16. *Calamospora sp.*, proximal face; V.44226.

Fig. 17. *Granulatisporites parvus* (Ibr.) Pot. and Kr., proximal face; V.44228.

Figs. 18–20. *Cyclogranisporites varius* sp. nov. 18, Distal face; V.44251. 19, Proximal face; V.44223. 20, *C.* cf. *parvipunctatus* (Kos.) Bhard., proximal face; V.44239.

Figs. 21–22. *Schopfites lateralis* sp. nov. 21, Laterally compressed, proximal face smooth; V.44235. 22, Proximal face; V.44222.

Figs. 23–26. *Lophotriletes spp.* 23, *L. sparsus* sp. nov., Proximal face; V.44220. 24–25. *L. novicus* sp. nov. 24, Proximal face; V.44220. 25, Proximal face; V.44221. 26, *L. sp.*, proximal face; V.44260.

Fig. 27. *Apiculatisporis decorus* sp. nov., proximal face; V. 44261.

Fig. 28. *Neoraistrickia pilata* sp. nov., proximal face; V.44224.

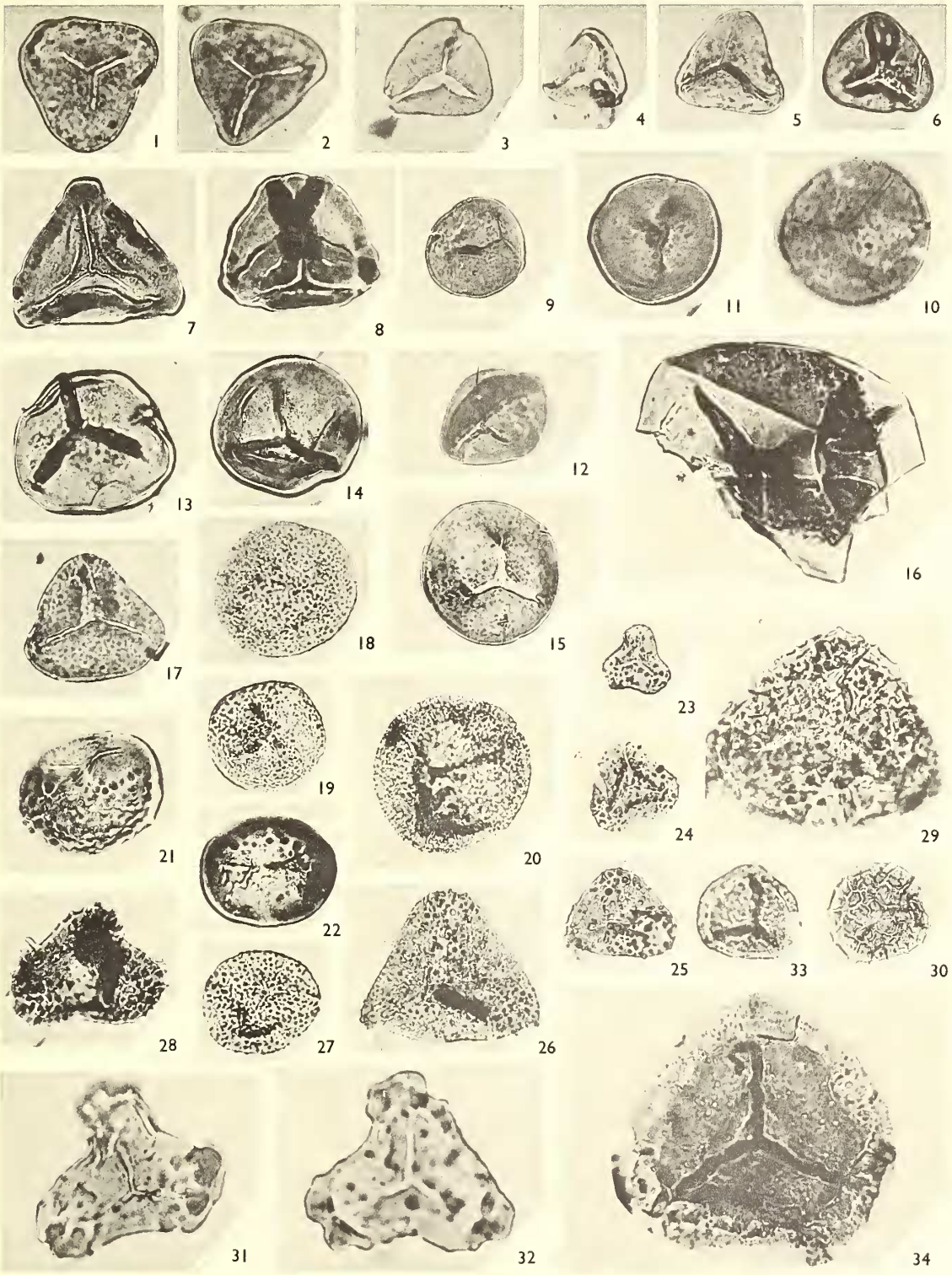
Fig. 29. *Camptotriletes sp.*, proximal face; V.44220.

Fig. 30. *Lycopodiumsporites sp.*, distal face; V.44221.

Figs. 31–32. *Triquitrites iraqiensis* sp. nov. $\times 1{,}000$. 31, Proximal face; V.44222. 32, Proximal face; V.44247.

Fig. 33. *Anguisporites minutus* sp. nov., proximal face; V.44252.

Fig. 34. *Cirratriradites surangei* sp. nov., proximal face; V.44224.



SINGH, Permian miospores

the radius but not reaching the equator; interradial thickening of the exine prominent and dark. Exine intrapunctate and folded. Margin of the spore smooth.

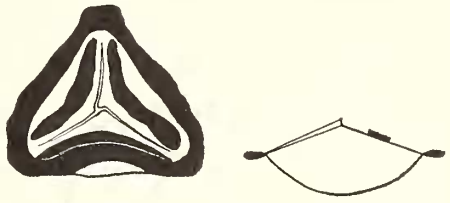
Comparison. L. atshaneusis, *L. magnificus*, and *L.* cf. *gracilis* lack the prominent interradial thickening of the exine of *L. rarus* and hence do not compare with the latter.

Genus IRAQISPORA gen. nov.

Text-fig. 1*a*, *b*

Type species. Iraqispora labrata gen. et sp. nov.

Generic diagnosis. Miospores triangular to subtriangular, angles sharply to broadly rounded. Trilete mark always prominent, Y-rays reaching up to or ending just before the equator, characteristically bent near the apex, interradial thickening broad near the Y-mark. Exine thicker at the equator, sometimes even thicker at the angles, thinner and lighter elsewhere, perceptibly sculptured.



TEXT-FIG. 1. A, *Iraqispora labrata* gen. et sp. nov. in polar view, proximal face; B, the same in median section. V.44256, ×500.

Comparison. Dictyophyllidites Couper and *Paraconcavisporites* Klaus are similar to *Iraqispora* in having comparable types of Y-mark and interradial thickening near the Y-mark but both of these form genera differ widely from the latter in lacking thickened exine near the equator. Other genera such as *Gleicheniidites* (Ross) Delc. & Sprum., *Concavisporites* (Pflug) Delc. & Sprum., and *Ahrensisporites* Pot. & Kr. differ from *Iraqispora* in usually having concave sides, straight Y-rays and exine with a different distribution of thickening.

Iraqispora labrata sp. nov.

Plate 44, figs. 7, 8

Holotype. Plate 44, fig. 7; slide V.44256.

Diagnosis. See generic diagnosis.

Description. Holotype 48×42 μ, dark brown, triangular in polar view with convex sides and round (or more or less flat) corners. Trilete mark conspicuous, Y-rays long, reaching or ending just before the equator, labra thick, elevated, characteristically bent at the apex, interradial thickening of the exine near the vicinity of trilete apparatus arcuate, 4–7 μ broad, darker and thicker. Equatorial exine about 5 μ thick or more so at the angles, lighter and thinner elsewhere; finely intrapunctate to punctate proximally and distally. Margin of the spore smooth.

Genus *Punctatisporites* (Ibrahim) Potonié and Kremp 1954

Punctatisporites obliquus Kosanke

Plate 44, fig. 9

Remarks. The specimen figured here (5 specimens examined) appears to have a thicker exine as compared to the illustration of the holotype of *P. obliquus*. But its other

morphographic characters such as size, shape, triradiate mark, length and nature of the Y-rays and exine ornamentation are the same as that of *P. obliquus*.

Punctatisporites pyramidicus sp. nov.

Plate 44, fig. 10

Holotype. Plate 44, fig. 10; slide V.44237.

Diagnosis. Size 40–60 μ (10 specimens), circular to subtriangular, Y-rays reaching the radius, exine 2·5 to 3·5 μ thick, dark brown, laevigate, proximal surface deeply convex, distal surface $\pm$flat.

Description. Holotype 44 μ across, $\pm$circular in polar view. Triradiate mark apparent, Y-rays long and extending up to the full length of the radius, simple, ray-ends bifurcating. Exine 2·5 μ thick in optical section, laevigate. Spore surface proximally convex, distally flat. Margin of the spore smooth.

Comparison. *Punctatisporites gretensis* Balme and Henn., occurring in the Permian of Australia (Balme and Henn. 1956) and Tanganyika (Hart 1960), differs from *P. pyramidicus* by having an apparently ornamented exine, and shorter Y-rays. In *P. punctatus* Ibr. Y-rays extend up to the equator and the exine is thinner. Other species of *Punctatisporites* do not compare closely.

Remarks. From the description of *Punctatisporites pyramidicus*, it might seem that it could as well either be referred to *Stenozonotriletes* (Naum.) Pot. 1956, or *Asterocalamotriletes* (Luber) Pot. 1958, if the thickening of the exine be interpreted in terms of a cingulum. The presence of a wide suture and the type of bifurcation of the ray-ends before the equator, as illustrated by Potonié (1958, pl. 2, fig. 17) for the emended diagnosis of the type species of *Asterocalamotriletes* and the union of the Y-rays with the central body and cingulum, is not apparent in the specimens which I have referred to *P. pyramidicus*. The other genus *Stenozonotriletes* has a distinct cingulum and apparently shorter Y-rays and thus it cannot accommodate such spores as those described here under *P. pyramidicus*.

Punctatisporites spathulatus sp. nov.

Plate 44, figs. 11, 12

Holotype. Plate 44, fig. 12; slide V.44224.

Diagnosis. Size 40–50 μ (10 specimens), circular to subcircular, Y-rays two-thirds to three-quarters the radius, labra thick, exine about 2 μ thick, laevigate.

Description. Holotype 44 μ, miospores assuming different contours due to folding of the exine. Triradiate mark prominent with sinuous and raised Y-rays, reaching nearly three-quarters the radius, labra thick. Exine about 1·5 μ thick in optical section, laevigate. Margin of the spore smooth.

Comparison. In *Punctatisporites pyramidicus* the Y-rays are longer and thinner. *P. obliquus* has a thinner exine. *P. sp.* (below) differs in having longer Y-rays, broader labra, and a thinner exine.

Punctatisporites sp.

Plate 44, figs. 13, 14

Description. Circular in polar view, 48 μ across. Triradiate mark very prominent, Y-rays reaching more than three-quarters the radius, elevated, labra 3·5 μ broad, not flexuose. Exine thin, intrapunctate. Margin of the spore smooth.

Comparison. Punctatisporites sp. has a more prominent Y-mark than any other known species of this genus. Only two specimens were found.

Genus RETUSOTRILETES Naumova 1953
? Retusotriletes sp.

Plate 44, fig. 15

Description. Size 40–50 μ, circular in polar view. Trilete mark prominent, Y-rays extending up to or more than three-quarters the radius, ray-ends marked by broad contact faces, curvaturae appear to be incomplete. Exine about 1·5 μ thick, thicker at the equator, intrapunctate, lighter at the contact faces.

Genus CALAMOSPORA Schopf, Wilson and Bentall 1944
Calamospora sp.

Plate 44, fig. 16

Description. Size 100–150 μ, originally circular but appears variable in shape owing to secondary folds in the exine. Triradiate mark conspicuous, tecta flexuose and reaches two-thirds of the radius, elevated, slightly sinuous, contact area not apparent. Exine about 1 μ thick in optical section, finely structured, secondary folds large. Margin of the spore smooth.

Comparison. C. diversiformis Balme and Henn. is smaller (24–53 μ), with a thicker spore coat and a distinct contact area. *C. breviradiata* Kosanke and *C. minuta* Bhardwaj compare with *C. sp.* in having flexuose tecta but both these species are appreciably smaller.

Infraturma APICULATI (Bennie and Kidston) Potonié 1956
Genus GRANULATISPORITES (Ibrahim) Potonié and Kremp 1958
Granulatisporites parvus (Ibrahim) Potonié and Kremp

Plate 44, fig. 17

Description. Size 36–40 μ (5 specimens), triangular in equatorial contour, sides more or less straight. Y-rays extending up to or slightly more than three-quarters of the radius. Exine about 1·5 μ thick, densely granulose.

Genus CYCLOGRANISPORITES Potonié and Kremp 1954
Cyclogranisporites varius sp. nov.

Plate 44, figs. 18, 19

Holotype. Plate 44, fig. 19; slide V.44223.

Diagnosis. Size 35–50 μ (50 specimens). Y-rays up to or slightly more than two-thirds radius long, exine ornamented with sparsely spaced, small grana and coni.

Description. Holotype 36 μ, circular in polar view, Y-rays conspicuous, one Y-arm usually longer than the other two. Exine covered with sparsely spaced grana and coni, grana outnumbering the coni, fifty to eighty in number along the perimeter.

Comparison. The specimens referred here to *C. varius* appear to me to represent a borderline case between the two genera *Cyclogranisporites* and *Planisporites* (Knox) Pot. and Kr. 1954 because these specimens possess both grana and small coni as ornamentation of the exine. In view of this, I have taken into consideration the distribution of grana along the perimeter of the spore and if they are represented by half or more, in comparison to the representation of coni, then I have included these specimens under *Cyclogranisporites*. If the proportion of coni is more than half, then I have described them elsewhere. The coni are extremely small, and can only be made out from the similarly small, neighbouring grana by their pointed ends which usually project beyond the margin of the flattened spores. This character of mixed sculptural elements of grana and coni separates *C. varius* from the other known species of *Cyclogranisporites*.

Cyclogranisporites cf. *parvipunctatus* (Kosanke) Bhardwaj

Plate 44, fig. 20

Description. Circular in polar view, 46 μ in diameter. Y-rays faintly discernible and extending up to nearly three-quarters the radius. Exine about 2 μ thick, beset with closely spaced, rounded sculptural elements which are rather longer than broad, giving a velvety appearance to the surface of the exine; about 180 elements are present along the perimeter. Both margin and surface appear rough.

Remarks. In the exine pattern the specimen of *C.* cf. *parvipunctatus* figured is comparable with the illustration of the holotype of *C. parvipunctatus* (Kos.) Bhard. and also with the specimens figured by Bhardwaj (1957, pl. 23, figs. 3–6) from the Saar coals, but it differs from the latter in the presence of longer Y-rays and bigger size.

Genus SCHOPFITES Kosanke 1950

Schopfites lateralis sp. nov.

Plate 44, figs. 21, 22

Holotype. Plate 44, fig. 21; slide V.44235.

Diagnosis. Size 36–52 μ (20 specimens), circular to oval in polar view, usually laterally flattened, Y-rays 10–15 μ long, elevated, distal surface beset with sparsely to closely spaced, rounded warts of variable shape, measuring 2·6 μ–4·4 μ in diameter.

Description. Holotype 38 μ, dark brown, originally circular in equatorial contour but appearing oval due to lateral flattening. Exine about 3 μ thick, laevigate proximally, and distally covered with rounded rather variable wart-like elements which tend to extend slightly on to the proximal surface. The exine between the warty projections is punctate.

Comparison. S. dimorphus Kos. and *S. colchesterensis* Kos. are described by Kosanke (1950) from the Carbondale Formation of the Pennsylvanian of Illinois. Both these species differ from *S. lateralis* in being larger (78–115 μ). *S. saarensis* Bhard. has exine ornamentation of coni and in this character it does not compare with *S. lateralis*.

Genus LOPHOTRILETES (Naumova) Potonié and Kremp 1954

Lophotriletes sparsus sp. nov.

Plate 44, fig. 23

Holotype. Plate 44, fig. 23; slide V.44220.

Diagnosis. Size 20–25 μ (10 specimens), triangular, sides concave, Y-rays two-thirds radius in length, exine ornamented with small sparse coni, ten to fifteen in number along the perimeter.

Description. Holotype 22 μ, with concave sides and broadly rounded angles. Triradiate mark clear; sometimes one Y-arm tends to be longer than the other two, and the interradial exine darker than the remainder in some specimens. Exine about 1 μ thick in optical section, ornamented with very sparsely spaced, small coni of irregular size, the space between the adjoining coni often granulose.

Comparison. In size and length of Y-rays *L. commissuralis* and *L. sparsus* are comparable but the ornamentation in the former is denser and thicker.

Lophotriletes novicus sp. nov.

Plate 44, figs. 24, 25

Holotype. Plate 44, fig. 24, slide V.44220.

Diagnosis. Known size 26–32 μ (5 specimens), triangular, sides concave, Y-rays two-thirds of the radius or more, interradial area thickened, exine ornamented with coni, aggregating at the corners, about thirty in number along the equator.

Description. Holotype 25 μ, triangular with concave sides and broadly rounded angles. Y-rays two-thirds the radius in length, interradial exine thickened. Exine bearing small, widely spaced coni, more densely aggregated at the corners, thirty in number along the perimeter.

Comparison. No previously described species of *Lophotriletes* shows this character of large coni, densely aggregated at the corners and thickened interradial exine.

Remarks. In most of the specimens referable to *L. novicus* the exine is ornamented with coni but in some cases (e.g. Pl. 44, fig. 26) in addition to coni, there are elements which are more comparable to baculae than coni.

Lophotriletes sp.

Plate 44, fig. 26

Description. Miospore triangular in equatorial contour, sides $\pm$straight with broad angles. Trilete mark distinct, Y-rays ending just before the apices. Exine about 1 μ thick, beset with coni of varying sizes, interspersed with fewer, flat-tipped baculae, sculptural elements apparently tend to aggregate more at the apices than elsewhere. Out of fifty-five processes present along the circumference, forty-five are coni and the rest are baculae.

Remarks. The specimen figured here is the only representative of its kind met with in this spore assemblage. As evident from the description and illustration of the specimen, the

exine has a combination of mixed sculptural elements, with more coni than small bacula. On account of this, it has been tentatively assigned to the genus *Lophotriletes* although the presence of bacula suggests its comparison with *Conbaculatisporites* Klaus.

Genus APICULATISPORIS Potonié and Kremp 1956

Apiculatisporis decorus sp. nov.

Plate 44, fig. 27

Holotype. Plate 44, fig. 27; slide V.44261.

Diagnosis. Size 35–45 μ (30 specimens), Y-rays two-thirds to three-quarters radius long, two Y-arms usually longer than the third, exine thin, ornamented with sparsely spaced, small coni, forty to sixty in number along the perimeter.

Description. Holotype 38 μ, circular, secondary folds rare. Triradiate mark usually apparent, sometimes faint or obscure, Y-rays simple, unequal, running two-thirds to three-quarters of the radius, ray-ends not bifurcating. Exine about 1 μ thick in optical section, covered with sparsely spaced, small coni; the average space between two coni could accommodate one to two more coni of similar size.

Comparison. A. decorus has smaller coni than any other species of *Apiculatisporis*. In this respect, it approaches the genus *Planisporites* (Knox) Pot. and Kr. *A. latigranifer* (Loose) Imgr. has somewhat comparable coni but it is distinctly bigger (55–90 μ) than *A. decorus*.

Genus NEORAISTRICKIA Potonié 1956

Remarks. Potonié (1956) has instituted *Neoraistrickia* to accommodate spores which are triangular and have baculate ornamentation, citing *Triletes truncatus* Cookson (1953, pl. 2, fig. 36) as its type species. The figure of the type species of *Neoraistrickia* shows more or less convex sides. The specimens described here, have comparable ornamentation with the type species of *Neoraistrickia*, but they have more or less concave sides. Despite this difference, I have included such forms in *Neoraistrickia*. Similar specimens have been noted by Hart (1960, p. 4) occurring in the East African material but they have not been figured or described by him.

Neoraistrickia pilata sp. nov.

Plate 44, fig. 28

Holotype. Plate 44, fig. 28; slide V.44224.

Diagnosis. Size 40–50 μ (10 specimens), sides more or less concave, Y-rays more than three-quarters the radius, exine baculate, bacula 1–3 μ broad at the base, 2–5 μ long, numbering thirty to thirty-five along the perimeter, tending to aggregate at the angles.

Description. Holotype 48 μ, triangular with more or less concave sides and broad angles. Triradiate mark clear, Y-rays the length of the radius. Exine about 1 μ thick in optical section, baculate, bacula tending to concentrate at the angles, sparsely spaced at the sides.

Comparison. Both *N. truncata* (Cooks.) Pot. and *N. neozealandica* (Coup.) Pot. are species of younger horizons occurring in the Tertiary and Jurassic strata respectively.

Both these species differ from *N. pilata* in having bigger bacula. *N. ramosa* (Balme and Henn.) Hart has more or less convex sides and bigger bacula.

Infraturma MURORNATI Potonié and Kremp 1954
Genus CAMPTOTRILETES Naumova 1937
Camptotriletes sp.

Plate 44, fig. 29

Description. Miospore triangular, 64 × 56 μ, sides straight-convex, angles broad. Y-rays three-quarters of the radius in length, simple, open, ray-ends hair-thin. Exine brownish red, about 2·5 μ thick in optical section, covered with coni 3–4·5 μ broad, 2–3 μ high and sharply tipped. The bases of the coni are confluent, thus building rudimentary cristae; the proximal exine is intrapunctate.

Comparison. Camptotriletes biornatus Balme and Henn. is bigger (89–127 μ) and possesses coarser verrucae.

Genus LYCOPODIUMSPORITES Thiergart 1938
Lycopodiumsporites sp.

Plate 44, fig. 30

Description. Miospore subcircular in equatorial contour, measuring 34 μ across. Trilete mark faint but discernible, Y-rays reaching three-quarters the radius. Exine reticulate, proximally as well as distally, meshes polygonal, 5–7 μ broad, four to six in number across the diameter, muri thin and high, fine grana evident both on the proximal and distal surfaces.

Remarks. Only two specimens referable to the genus *Lycopodiumsporites sp.* have been found from this assemblage. Both these specimens show reticulate exine on the proximal as well as distal surface.

Turma ZONALES (Bennie and Kidston) Potonié 1956
Subturma AURITOTRILETES Potonié and Kremp 1954
Infraturma AURICULATI (Schopf) Potonié and Kremp 1954
Genus TRIQUITRITES Wilson and Coe 1940
Triquitrites iraqiensis sp. nov.

Plate 44, figs. 31, 32

Holotype. Plate 44, fig. 32; slide V.44247.

Diagnosis. Size 25–30 μ (5 specimens), Y-rays almost extending up to the angles, angles bearing cushion-like auriculae, projecting beyond the spore margin but limited only to the angles, exine punctate, puncta 0·5 to 1 μ in diameter.

Description. Holotype 26 μ, triangular in polar view with concave sides having cushion-like auriculae at the angles. Auriculae, irregular in shape, tending to bifurcate. Y-mark clear, Y-rays reaching up to the inner margin of the auriculae. Exine thin, punctate, puncta variable in size, auriculae darkbrown, limited only to the angles, with no equatorial connexion by a flange.

Comparison. Triquitrites brevipulvinatus Bhard. is comparable but it differs from *T. iraqiensis* in having a smooth exine. *T. priscus* Kos., reported from the Permian of Gondwanaland by Leschik (1959), does not compare. *T. protensus* Kos. has been reported from the Lower Permian of the Kaiping basin by Imgrund (1960) and it differs from *T. iraqiensis* in having a laevigate exine.

Subturma ZONOTRILETES Waltz 1935
Infraturma CINGULATI Potonié and Klaus 1954
Genus ANGUISPORITES Potonié and Klaus 1954
Anguisporites minutus sp. nov.

Plate 44, fig. 33

Holotype. Plate 44, fig. 33; slide V.44252.

Diagnosis. Size 28–35 μ (15 specimens), central body subtriangular surrounded by an equatorially attached cingulum, Y-mark as long as the radius not extending beyond the central body, exine granulose on both the faces.

Description. Size 28–35 μ (15 specimens). Holotype 30 μ, subtriangular to almost circular with a subtriangular central body, measuring 22 μ in the holotype, surrounded by an equatorially attached cingulum, uniformly about 4 μ broad. Trilete mark prominent, Y-rays as long as the radius, not extending beyond the central body, labra thick and undulating. Exine of the central body granulose proximally as well as distally. Cingulum coarsely granulose. Surface and margin of the spore rough.

Comparison. A. anguinus Potonié and Klaus is just double the size of *A. minutus.* Grebe (1957, pl. 1, fig. 10) has figured cf. *A. anguinus* from the Zechstein, Germany, which is not a very clear specimen. However, it falls within the size range of *A. minutus. A. intonsus* Wilson also differs from *A. minutus* in being larger (48–55 μ). *A. contortus* Wilson has contorted ornamentation of the body exine.

Infraturma ZONATI Potonié and Kremp 1954
Genus CIRRATRIRADITES Wilson and Coe 1940
Cirratriradites surangei sp. nov.

Plate 44, fig. 34; Plate 45, fig. 1

Holotype. Plate 44, fig. 34; slide V.44224.

Diagnosis. Size 75–100 μ (10 specimens), subtriangular to subcircular, central body subtriangular, about 50 μ, flanged by an equatorial zona, about 9 μ broad, Y-rays raised, long, extending into the zona, labra thick, undulating, exine of the central body finely granulose, having small coni of variable size; one to three circular to triangular distal polar foveolae apparent.

Description. Holotype 80 μ, subtriangular in polar view, having a subtriangular central body, surrounded by an equatorially attached flange. Central body darker in colour as compared to the flange, proximally bearing a conspicuous Y-mark; Y-rays undulating and running over a part of the zona, labra dark, thick and elevated. Exine granulose both on the distal and proximal faces of the central body, interspersed with very widely spaced coni of variable size and form in the same specimen. Distally the central body

has a distinct triangular area composed of a thinner central exine, surrounded by a thicker border. Zona finely structured or sculptured. Margin of the spore irregular.

Comparison. *C. splendens* Balme & Henn. does not show such thick labra and undulating Y-mark and distal foveolae, as does *C. surangei.* In *C. annuliformis* Kos. and Brok., the central body exine is punctate. *C. difformis* Kos. differs in having faintly reticulate exine of the central body. *C. annulatus* Kos. & Brok. is comparable with *C. surangei* but it differs from the latter by lacking grana and coni on its exine.

Turma MONOLETES Ibr. 1933
Subturma AZONOMONOLETES Luber 1935
Infraturma LAEVIGATOMONOLETI Dybova and Jachowitz 1957
Genus LAEVIGATOSPORITES Ibrahim 1933
Laevigatosporites sp.

Plate 45, fig. 2

Description. Miospore 84×62 μ, bilateral. Monolete-slit three-quarters the length of the spore or ending just before the poles. Exine appears structured and also corroded. Secondary folds present.

Genus LATOSPORITES Potonié and Kremp 1954
Latosporites intragranulosus sp. nov.

Plate 45, figs. 3, 4

Holotype. Plate 45, fig. 3; slide V.44241.

Diagnosis. Size 88–110 μ (5 specimens), broadly oval to subcircular, monolete mark two-thirds to three-quarters the radius, exine intragranulose, distally strongly arched.

Description. Holotype 90 μ, broadly oval to subcircular in polar view having distal surface strongly arched, apparent on lateral flattening of the spores. The monolete mark is usually two-thirds the radius in length, sometimes extending up to three-quarters the radius. Exine about 1 μ thick in optical section, densely intragranulose, grana fine. Margin of the spore smooth.

Comparison. This species is larger, and has a longer monolete-slit than any comparable species of *Latosporites. L. colliensis* (Balme and Henn.) Bharad. differs from *L. intragranulosus* by having a perfectly smooth exine.

Latosporites ficoides (Imgr.) Potonié and Kremp

Plate 45, fig. 5

Remarks. Only three specimens of this species were found.

Infraturma SCULPTATOMONOLETI Dybova and Jachowitz 1957
Genus PUNCTATOSPORITES Ibrahim 1933
Punctatosporites marattioides sp. nov.

Plate 45, figs. 6–8

Holotype. Plate 45, fig. 7; slide V.44255.

Diagnosis. Size 22–30 μ (50 specimens) oval, monolete-slit three-quarters of the radius or longer, exine granulose, grana very fine.

Description. Holotype 22 μ, yellowish-brown, oval in polar view. Monolete mark prominent, slit straight, usually open, slit-ends not bifurcated. Exine about 1 μ thick in optical section, granulose, grana small and closely spaced. Margin of the spore appears beaded.

Comparison. P. marattioides has finer grana and usually a longer monolete mark than *P. minutus* Ibr. *P. scabellus* (Imgr.) Pot. and Kr. and *P. major* Bhard. are larger with coarser grana. *P. rotundus* Bhard. and *P. granulatus* Bhard. differ in having circular shape and a smaller monolete-slit respectively. The equatorial contour of *P. nanulus* (Imgr.) Pot. and Kr. is ellipsoidal while *P. pygmaeus* (Imgr.) Pot. and Kr. differs in having the monolete-slit only half the radius long.

Genus THYMOSPORA Wilson and Venkatachala 1963

Thymospora opaqua sp. nov.

Plate 45, figs. 9–11

Holotype. Plate 45, fig. 11; slide V.44276.

Diagnosis. Size 24–33 μ (50 specimens), circular to subcircular, monolete-slit three-quarters of the radius or longer, exine dark brown, verrucose; verrucae 2–4 μ broad, 1–2·5 μ high, fourteen to twenty-six in number along the perimeter.

Description. Holotype 26 μ, more or less circular. Monolete-slit distinct, straight to curved, thin, labra indistinct, slit-ends not bifurcated. The exine is thick (exact thickness not measurable due to warty exine), verrucose, verrucae of variable size and shape, projecting beyond the spore margin where they tend to bifurcate occasionally; sometimes their bases are confluent. In addition to the verrucae, fine grana are distributed all over the exine.

Comparison. T. verrucosa (Alpern) Wilson and Venkatachala has almost the same size range as that of *T. opaqua* but the fainter monolete mark and coarser verrucae with sharper ends differentiates it from the latter. *T. amblyogona* Imgr. possesses a shorter monolete-slit and appears to have fewer verrucae; otherwise, it is very closely comparable to *T. opaqua*. Other Permian speies of *Thymospora* reported by Balme and

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EXPLANATION OF PLATE 45

All figures are from unretouched negatives and unless otherwise stated are ×500.

Fig. 1. *Cirratriradites saurangei* sp. nov., distal face; V.44230.

Fig. 2. *Laevigatosporites sp.*, proximal face; V.44226.

Figs. 3–5. *Latosporites spp.* 3–4. *L. intragranulosus* sp. nov. 3, Proximal face; V.44241. 4, Proximal face; V.44259. 5, *L.* cf. *ficoides* (Imgr.) Pot. and Kr., laterally compressed; V.44231.

Figs. 6–8. *Punctatosporites marattioides* sp. nov. 6, Proximal face; V.44268. 7, Proximal face; V. 44255. 8, Proximal face; V.44245.

Figs. 9–11. *Thymospora opaqua* sp. nov. 9, distal face; V.44225. 10, proximal face; V.44228. 11, Proximal face; V.44276.

Fig. 12. *Nuskoisporites sp.*, proximal face; V.44234.

Figs. 13–15. *Mosulipollenites circularis* gen. et sp. nov. 13, Proximal face; V.44222. 14, Distal face; V.44226. 15, Proximal face; V.44222.

Figs. 16–18. *Potonieisporites spp.* 16, *P. bilateralis* sp. nov., proximal face; V.44224. 17, *P.* cf. *neglectus* Pot. and Lele, proximal face; V.44222. 18, *P. sp.*, proximal face; V.44236.


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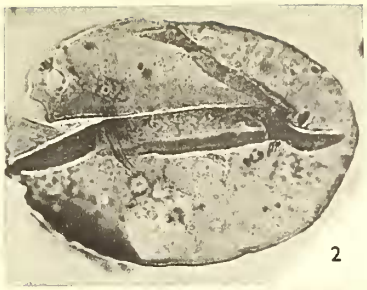
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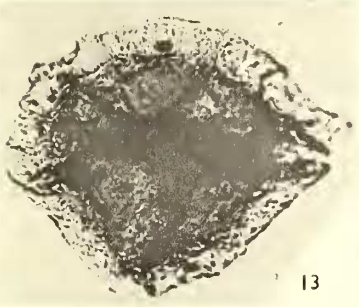
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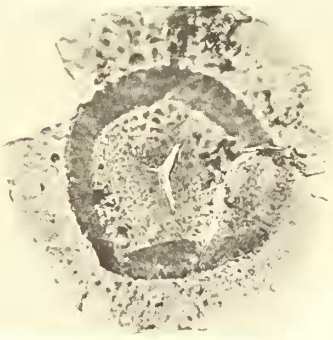
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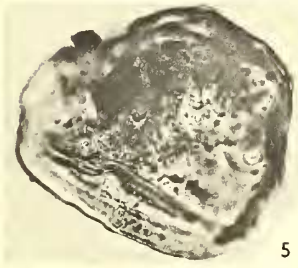
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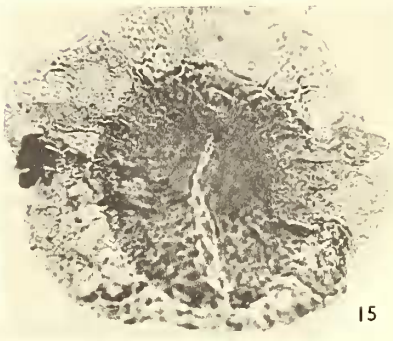
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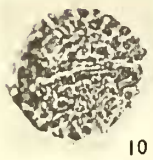
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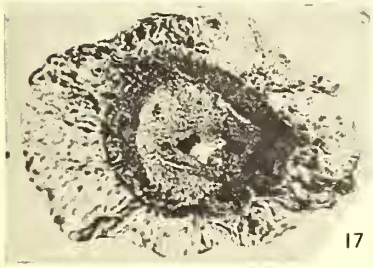
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SINGH, Permian miospores

Hennelly (1956) and Leschik (1959) from Australia and South-west Africa respectively are not closely comparable.

Remarks. The morphographic characters of *T. opaqua* show a wide range of variation. The shape, size and number of verrucae along the perimeter of the miospore are so variable that from the casual observations it appeared that perhaps the population of *Thymospora* represented in this assemblage might consist of two or more distinct species. Therefore, a number of specimens were examined and the number of verrucae along the circumference plotted against the spore size. The resulting distribution diagram gave no indication (in these characters, at least) that the population shows any clear discontinuity.

Anteturma POLLENITES Potonié 1931
Turma SACCITES Erdtman 1947
Subturma MONOSACCITES (Chitaley) Potonié and Kremp 1954
Infraturma TRILETESACCITI Leschik 1955
Genus NUSKOISPORITES Potonié and Klaus 1954
Nuskoisporites sp.

Plate 45, fig. 12

Description. Circular in polar view, 88 μ in diameter, with subcircular central body, surrounded by a sub-equatorially attached saccus. Central body brownish-yellow, exine coarseley granulose, proximally as well as distally, unequally thick, secondary folds evident. Y-rays asymmetric with one Y-arm shorter than the other two. Saccus around the central body about 16 μ broad, intrareticulate. Limbus faintly perceptible.

Comparison. The species described here differs from *N. rotatus* Balme and Henn., in having thicker central body exine and faintly developed limbus. *N. gondwanensis* Balme and Henn. has thinner body exine and coarser saccus, showing radial orientation of the elements. *N. klausi* Grebe has longer Y-rays and coarser body exine. *N. dulhuntyi* Pot. and Kl. differs in having a symmetric Y-mark and well-developed limbus.

Infraturma VESICULOMONORADITES (Pant) Bhardwaj 1955
Genus MOSULIPOLLENITES gen. nov.

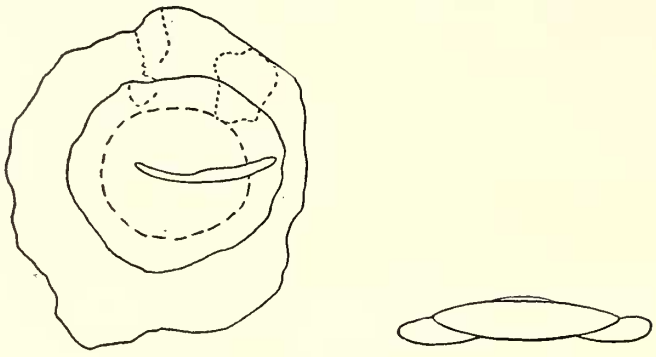
Plate 45, fig. 15; text-fig. 2*a*, *b*

Type species. Mosulipollenites circularis sp. nov.

Diagnosis. Monosaccate, ±circular in polar view. Central body circular to oval, usually dark, dense and granulose. Monolete-slit apparent. Saccus usually unequally broad, attached sub-equatorially to the central body, intrareticulate. Secondary folds usually apparent running on or across the central body.

Comparison. Mosulipollenites differs from *Potonieisporites* Bhard. in lacking two series of folds which are reported to be characteristic for the latter genus. *Vestigisporites* (Balme and Henn.) Hart is bilateral in symmetry, ranging from monosaccate to bisaccate condition and usually does not have secondary folds on the central body. In *Hoffmeisterites* Wil. the distal attachment of the saccus is below the equator and the compression

folds on the proximal face of the body show a polygonal configuration, demarcating the area of the sulcus distally. *Saturnisporites* Kl. is reported to possess a zona around the central body and the exine in both these is usually finely punctate to granulose, often bearing short hairs. In these characters *Saturnisporites* differs from *Mosulipollenites*.



TEXT-FIG. 2. A, *Mosulipollenites circularis* gen. et sp. nov. in polar view, proximal face; B, the same in median section. V.44223, ×500.

Mosulipollenites circularis sp. nov.

Plate 45, figs. 13–15

Holotype. Plate 45, fig. 15; slide V.44222.

Diagnosis. The same as generic diagnosis.

Description. Holotype about 90 μ, monosaccate, 60–104 μ (10 specimens) central body dark brown, broadly oval, about 64 μ broad, saccus unequally broad, 4–20 μ, subequatorially attached. Exine of the central body granulose all over, secondary folds usually present on the proximal as well as distal surface, folds irregularly arranged, running to and from the central body and the saccus. Monolete mark discernible, sometimes obscure due to the presence of thick folds, slit-ends usually sinuous, running the full length of the diameter and sometimes entering the saccus region. Saccus less broad as compared to the central body, distally leaving a more or less bladder-free circular area.

Genus POTONIEISPORITES Bhard. 1954

Potonieisporites bilateralis sp. nov.

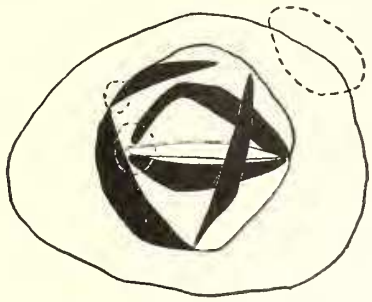
Plate 45, fig. 16

Holotype. Plate 45, fig. 16; text-fig. 3; slide V.44224.

Diagnosis. Size 100–130 μ (5 specimens), bilateral, two central body folds crescentic, longitudinal, enclosing a horizontal, monolete-slit. Bladder intrareticulate.

Description. Holotype 124 μ, with a subcircular to oval central body, having a long monolete-slit, running parallel to the longer axis, open, slit-ends not bifurcated. Secondary folds dark, lying perpendicular to the slit-ends near the periphery of the central body. Exine thick, dark brown, indeterminably ornamented. Bladder of variable width, intrareticulate, meshes small.

Comparison. P. bilateralis has a dark subcircular to oval central body, and possesses only one set of folds; it is thus not comparable to *P. novicus* Bhard. which has a circular central body and a double set of folds. *P. neglectus* Pot. and Lele differs from *P. bilateralis* in having a trapezoidal central body and finer meshes of the saccus.



TEXT-FIG. 3. *Potonieisporites bilateralis* sp. nov.; proximal face showing the monolete mark and the folding of the central body exine; V.44224, ×500.

Potonieisporites cf. *neglectus* Pot. and Lele

Plate 45, fig. 17

Holotype. Potonié and Lele 1959, pl. 3, fig. 64.

Remarks. The organization of the specimen figured here is comparable to *P. neglectus* but differs from it in having a shorter monolete-slit.

Potonieisporites sp.

Plate 45, fig. 18

Description. Miospore 82 μ, bilateral, central body oval to elliptical, having two series of folds (as described by Bhardwaj 1954). Monolete-slit presumably corresponding to a thinner patch of exine in the centre (parallel to the transverse axis of the miospore). Bladder intrareticulate, radially folded, without any recognizable limbus.

Comparison. It differs from *P. bilateralis* and *P. novicus* Bhard. in having an ill-defined monolete mark and radially directed elements of the bladder.

Genus VESTIGISPORITES Balme and Hennelly *emend.* Hart 1960

Remarks. In the diagnosis of *Vestigisporites*, Balme and Hennelly (1955, p. 95) have included both the disaccate and monosaccate forms. The type species of the genus, *V. rudis* (Balme and Henn. 1955, pl. 6, fig. 54), although disaccate, appears to have a lateral connective joining the two sacci. Later Hart (1960) emended the diagnosis of *Vestigisporites* and recognized the monosaccate organization of the forms referable to this genus, suggesting that the disaccate condition could have arisen on account of lateral reduction of the saccus. My observations, on two new species from this assemblage, *V. granulosus* sp. nov., and *V. densus* sp. nov., support Hart's view.

Vestigisporites granulosus sp. nov.

Plate 46, fig. 1

Holotype. Plate 46, fig. 1; slide V.44240.

Diagnosis. Size 90–110 μ (15 specimens), monosaccate tending to be disaccate, central body horizontally oval, granulose with a monolete mark, bladder attachment subequatorial.

Description. Holotype 106×70 μ, bilateral, monosaccate tending to be disaccate. Central body ill-defined, oval, elongated parallel to the overall elongation, granulose proximally as well as distally. Monolete mark present, about 20 μ long, open. Bladder attachment subequatorial, laterally usually confluent, notched at one side, bladder-free-area usually wide, intrareticulate, meshes fine.

Comparison. V. hennellyi Hart and *V. disectus* Hart differ from *V. granulosus* in having either a well-defined central body or a longer monolete mark, or both.

Vestigisporites densus sp. nov.

Plate 46, figs. 2, 3

Holotype. Plate 46, fig. 2; slide V.44225.

Diagnosis. Size about 120 μ, bilateral, monosaccate, tending to be bisaccate, central body dark brown, elongated parallel to the overall elongation, bladder meshes usually radially elongated.

Description. Holotype about 120 μ, bilateral, monosaccate pollen grain with dark brown oval central body bearing a straight to slightly raised monolete mark (presumably on the proximal surface) less than two-thirds radius long measured from the slit-ends. Exine of the central body intragranulose. Bladder much elongated, subequatorially attached and intrareticulate.

Comparison. No other species of *Vestigisporites* has such a dark brown and dense central body as is found in *V. densus.*

EXPLANATION OF PLATE 46

All figures are from unretouched negatives and unless otherwise stated are $\times 500$.

Figs. 1–3. *Vestigisporites spp.* 1, *V. granulosus* sp. nov., proximal face; V.44240. 2–3. *V. densus* sp. nov. 2, Proximal face; V.44225. 3, Distal face; V.44223.

Fig. 4. *Lueckisporites sp.*, proximal face; V.442230.

Figs. 5–8. *Striatites spp.* 5–7. *S. medius* sp. nov. 5, Proximal face; V.44274. 6, Proximal face; V.44263. 7, Proximal face; V.44231. 8, *S. richteri* (Klaus) Pot., proximal face; V.44221.

Fig. 9. *Striatopodocarpites crassus* sp. nov., proximal face; V.44231.

Fig. 10. *Vitreisporites* cf. *signatus* Lesch., proximal face; V.44246.

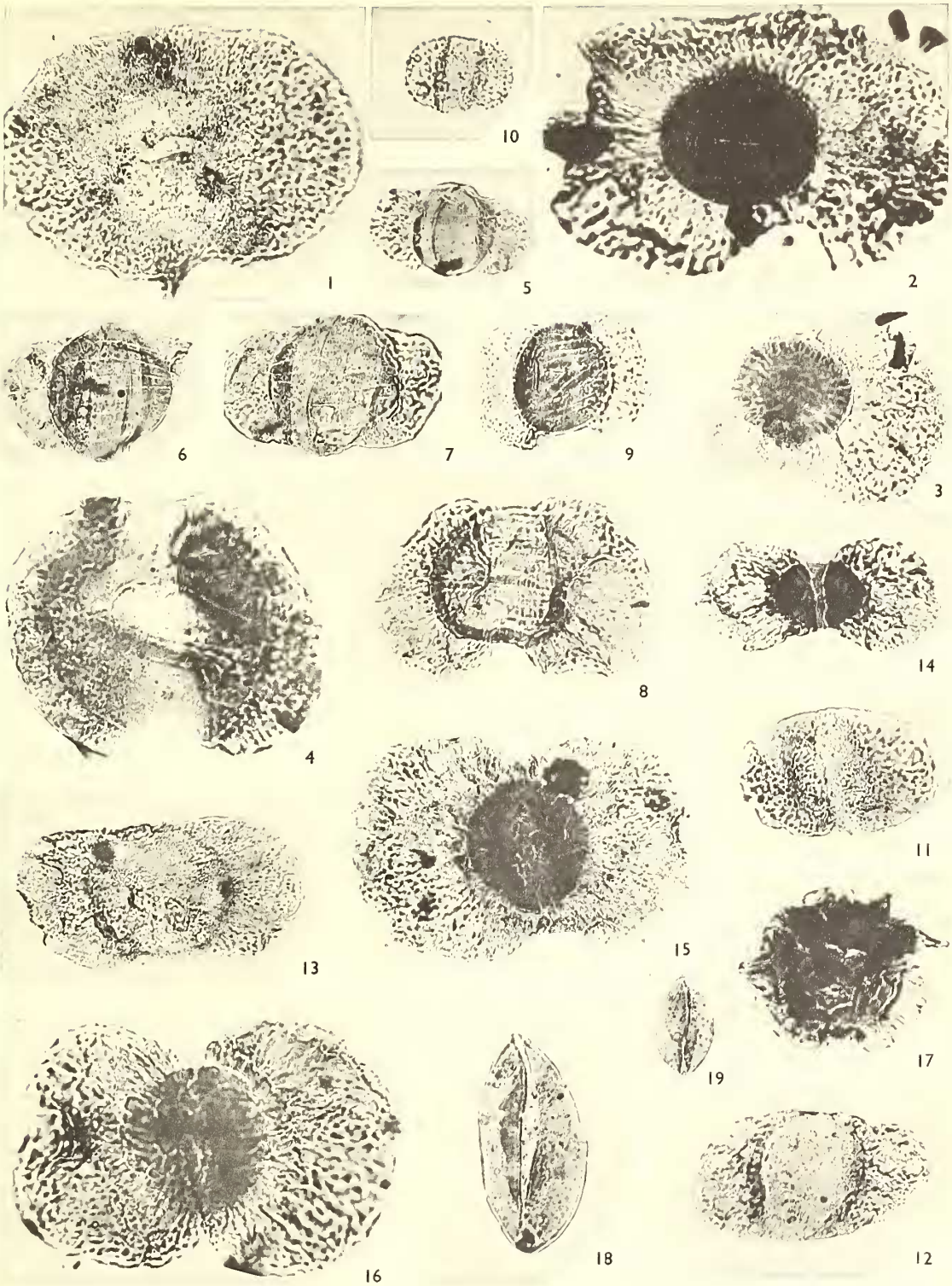
Figs. 11–13. *Vesicaspora spp.* 11–12. *V. obliqua* sp. nov. 11, Proximal face; V.44258. 12, Proximal face; V.44222. 13, *V. sp.*, proximal face; V.44248.

Fig. 14. *Platysaccus papilionis* Pot. and Kl., distal face; V.44258.

Fig. 15–16. *Fimbriaesporites fimbriatus* sp. nov. 15, Distal face; V.44226. 16, Proximal face; V.44226.

Fig. 17. *Kraeuselisporites obscurus* sp. nov., proximal face; V.44221.

Figs. 18–19. *Cycadopites.* 18, Sp. A, proximal face; V.44225. 19, Sp. B, proximal face; V.44221.



SINGH, Permian miospores

Subturma DISACCATES Cookson 1947
Infraturma STRIATITI Pant 1954
Genus LUECKISPORITES Potonié and Klaus emend. Potonié 1958
Lueckisporites sp.

Plate 46, fig. 4

Description. Pollen grain disaccate, diploxylonoid. Central body elongated parallel to the longest axis of the spore, bearing proximally two horizontal stripes, having a single groove between them. Bladders large, distally inclined, intrareticulate.

Remarks. This is the only specimen of its kind met with in this spore assemblage. On account of the poor preservation of the organic matter its identification is tentative.

Genus STRIATITES Pant emend. Bharadwaj 1960

Remarks. Bharadwaj (1960) has emended the diagnosis of *Striatites* stating that the pollen grains referable to it are disaccate with vertically oval to circular central body which bears horizontal striations with or without faint to prominent vertical striations at right angles to them and a microverrucose exine. Jansonius (1962) has also reinterpreted this genus but he makes no mention of the ornamentation of the central body exine. He distinguishes *Striatites* from *Lueckisporites* and *Taeniaesporites* on the basis of number of striations. *Striatites medius* sp. nov. (described below) from this assemblage has six to eight proximal horizontal striations on the central body but its exine ornamentation appears to be matt.

Striatites medius sp. nov.

Plate 46, figs. 5–7

Holotype. Plate 46, fig. 7; slide V.44263.

Diagnosis. Size 52–72 μ (15 specimens), pollen grain bisaccate, $\pm$haploxylonoid, central body 26–46$\times$22–40 μ, longitudinally oval, $\pm$narrower on one end. Exine $\pm$laevigate, bearing six to eight horizontal striations on the proximal surface, distally a longitudinal median suture evident (perpendicular to the longest axes). Bladders equal to, or slightly short of, the body height (perpendicular to the longest axis), intrareticulate, distally inclined.

Description. Holotype 62 μ along the longest axis (including sacci). Exine of the central body appears to be matt, bearing proximally eight horizontal striations, straight to anastomosing (not in the holotype) tending to converge at both the ends. Bladder attachment areas distinct, widely separate laterally as well as distally.

Comparison. S. richteri (Klaus) Pot. 1958 has a greater number of striations. *S. cancellatus* (Balme and Hennelly) Pot. 1958 differs in having a circular to subcircular central body.

Striatites richteri (Klaus) Potonié

Plate 46, fig. 8

Remarks. The miospores (10 specimens) referred here to *S. richteri* are somewhat smaller (68–84 μ in the longest axis) in size as compared to its holotype. This species has also been recorded by Jizba (1962) from the Mid-continent area of United States.

Genus STRIATOPODOCARPITES Soritscheva and Sedowa emend. Bharadwaj 1960

Striatopodocarpites crassus sp. nov.

Plate 46, fig. 9

Holotype. Plate 46, fig. 9; slide V.44231.

Diagnosis. Average size about 64 μ, pollen grains bisaccate (10 specimens), diploxylonoid, central body more or less circular, dark brown, horizontal striations eight to eleven, anastomosing, bladders more than semicircular.

Description. Holotype 62 μ, bilateral, bisaccate. Central body more or less circular; exine dense, dark brown, finely structured appearing almost matt, proximally striated, striations usually straight but sometimes anastomosing, particularly the middle ones, ten in number, distal slit not differentiated. Bladders distally inclined, intrareticulate, attachment areas discernible.

Comparison. S. octostriatus Hart has eight striations which do not anastomose. *S. fusus* (Balme and Henn.) Pot. differs in being larger and having fewer striations than *S. medius.*

Infraturma DISACCIATRILETI (Leschik) Potonié 1958

Genus VITREISPORITES Leschik 1955

1950 *Pityopollenites* Reissinger.
1958 *Caytonipollenites* Couper, *vide* Potonié 1960, p. 77.

Remarks. Leschik (1955) established *Vitreisporites*, stating that the pollen grains are bisaccate with a central body less than 20 μ and having a weak Y-mark on it. Recently Jansonius (1962) has emended this genus, rejecting the presence of Y-mark on the central body and a size smaller than 20 μ as characters of the genus. In the figure of the type species of *Vitreisporites* Leschik (1955, pl. 8, fig. 10) and in the specimen figured below as *V.* cf. *signatus*, a Y-mark has not been observed and this is in accordance with Jansonius's observation. However, the shape of the central body in *Vitreisporites* is variable from subcircular to oval and is not only subcircular as stated by Jansonius.

Vitreisporites cf. *signatus* Leschik

Plate 46, fig. 10

Description. The specimen figured here measures 32 μ and is bisaccate, more or less haploxylonoid having an elongate central body where height is more than breadth with laterally more or less flat sides. The exine is finely granulose both on the proximal and distal surfaces. No germinal aperture is visible. The attachment of the bladder with the body and other details of my specimen are comparable with those of the specimen figured by Leschik but for its larger size.

Genus VESICASPORA Schemel 1951

Remarks. Hart (1960) has referred three species from the Permian of East Africa to *Vesicaspora*, namely *V. maxima* Hart, *V. ovata* (Balme and Henn.) Hart, and *V. sulcata* Hart. The study of the figure of the holotype of *V. maxima* (Hart 1960, pl. 3, fig. 33) shows that its similarity with *Sulcatisporites* Lesch, is very striking, as it possesses an

indistinctly marked central body with bladders deeply infolded on the distal face. On the other hand *Vesicaspora* differs from *Sulcatisporites* in having a well-defined central body with the bladders continuous around the body. In view of these differences, I suggest that *V. maxima* should be transferred to *Sulcatisporites* as *Sulcatisporites maximus* (Hart) comb. nov.

Vesicaspora obliqua sp. nov.

Plate 46, figs. 11, 12

Holotype. Plate 46, fig. 12; slide V.44222.

Diagnosis. Size 60–90 μ (10 specimens), pollen grain bisaccate, haploxylonoid, central body more or less fusiform, bladders narrowing laterally.

Description. Holotype 90 μ, pollen grains bilateral, distinctly bisaccate with an elongate to fusiform central body, measuring 44×36 μ in the holotype, proximal as well as distal surface finely granulose, appearing microreticulate, striations absent. Bladders converge laterally and usually connected by a thin ledge, distally enclosing a bladder-free area of variable width, the line of attachment with the central body distinct, usually dark, intrareticulate, meshes small.

Comparison. V. wilsonia Schemel and *V. ovata* are smaller. *V. sulcata* Hart has a distal sulcus with thickened ends and hence in this respect is not comparable.

Vesicaspora sp.

Plate 46, fig. 13

Description. Size 90 μ, pollen grain bisaccate, haploxylonoid. Central body subcircular 44 μ in diameter, the body wall dark, the exine appearing microreticulate, striations absent, attachment with the body discernible, distal sulcus not differentiated, a narrow lateral connective joins the bladders.

Comparison. V. obliqua differs from *V. sp.* in having a fusiform central body.

Infraturma PODOCARPOIDITI Potonié, Thomson, and Thiergart 1950
Genus PLATYSACCUS (Naumova) Potonié and Klaus 1954
Platysaccus papilionis Potonié and Klaus

Plate 46, fig. 14

Remarks. The figure of the holotype of *P. papilionis* Potonié and Klaus shows a circular central body whereas in the specimen figured here, it is oval. Jizba (1962) has also recorded this species from the United States, Mid-continent area.

Genus FIMBRIAESPORITES Leschik 1959

Remarks. In its general organization *Fimbriaesporites* is very similar to *Platysaccus* Pot. and Kl., but its proximal exine appears reticuloid (although this is not clear in the figure of the type species of *Fimbriaesporites*) and this feature distinguishes it from *Platysaccus*. This character is very clearly seen in the specimens described here as *F. fimbriatus* sp. nov. In these specimens, it has been observed that the arrangement of rod-like bacula